UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

SYLLABUS DEL CORSO

Functional Analysis

2021-1-F5302Q002

Aims

The aim of the course is to provide some basic tools of Mathematical Analysis useful in the study of the differential equations of Classical Physics and Quantum Mechanics

Contents

Complex analysis. Fourier series. Fourier transform. Distributions and Dirac delta.

Detailed program

Complex Analysis

Complex functions. Holomorphic functions and harmonic functions. Cauchy's theorem. Laurent series. Residue theorem. Jordan Lemma. Calculation of integrals by means of residue theorem.

Fourier series

Fourier coefficients and series in real and complex form. Dirichlet theorem. Parseval formula.

Fourier transform

Classical Fourier tranform and antitransform. Properties of the Fourier transform. Parseval formula. Gaussian functions. Applications to the resolution of some partial differential equations. Calculation of Fourier transforms with

the residue theorem. Convolution.

Distributions

Schwartz space. Tempered distributions. Derivatives of distributions. Fourier transform of tempered distributions. Dirac delta distribution.

Prerequisites

Basic mathematical analysis: complex numbers, differential calculus for functions of one or several variables, ordinary and partial differential equations, integral calculus, series of functions.

Teaching form

Lectures and exercises. The course will be taught **in English**.

In the Covid-19 emergency period, the lessons will be taught in mixed mode:

- on Fridays partial presence in the classroom in small groups, The lesson is also transmitted synchronously via Webex (unless some technical problem should occur). The recording of the lecture will be available on e-learning by Friday evening.

- from Monday to Thursday (asynchronous) lectures and exercises are videorecorded and uploaded on the e-learning page before the scheduled time of the corresponding lesson / exercise.

Textbook and teaching resource

Some notes prepared by the teacher will be made available on the e-learning.

These notes can be supplemanted by textbooks, as for instance:

- Advanced engineering mathematics / Erwin Kreyszig. Wiley 10. ed. 2011 (available on Internet Archive at https://archive.org/details/AdvancedEngineeringMathematicsKreyszigE.10thEd/mode/2up)

- Methods of Applied Mathematics with a MATLAB Overview / John H. Davis. Birkhauser (available as an ebook at Bicocca Library)
- Applied Mathematics / Gerald Dennis Mahan. Kluwer 2002 (available as an ebook at Bicocca Library)
- K. F. Riley, M. P. Hobson and S. J. Bence. Mathematical Methods for Physics and Engineering, Cambridge University Press (available only in paper form at Bicocca Library)
- Advanced engineering mathematics / K.A. Stroud. Palgrave Macmillan. 6. ed. 2020. 978-1352010251

Semester

First Semester 2019-20. The course will end by the 13th of November.

Assessment method

A **written exam**, which consists in open questions about solution of exercises, problems or definitions.

During the Covid-19 emergency, the written exams could be held online only, by means of the WebEx platform and the esamionline e-learning platform.

The **oral exam** is not mandatory (except during the covid emergency), but can be asked either by the student or by the teacher in order to confirm or modify the score obtained at the written exam. Oral exams consist in: discussion of the written exam; questions on definitions, statements and (selected) proofs of theorems; solution of further exercises can be required.

During the Covid-19 emergency, the oral exams are mandatory and will be held online only, by means of the WebEx platform: a public link will be made available on the course's e-learning page, in order to allow the free access of the students sitting the exam and any virtual attendees

Office hours

By appointment, sending an e-mail to giona.veronelli@unimib.it. During the Covid-19 emergency, appointments will take place in remote.